

Claims

- 5           1. A thickness control system for controlling the thickness of a blown film by providing air to the blown film when in liquid form and provided from an extrusion die, the system comprising:
- 10           an inlet for receiving air;
- 15           lips for providing air to an external surface of the blown film as the blown film exits the die, the lips arranged to be around the blown film as the blown film exits the die;
- 20           radially oriented channels for directing air inwardly from the inlet to the lips such that all the air provided into the channel is passed through to the lips; and
- 25           a plurality of barriers movable relative to the channel, with at least one barrier in each of a number of the channels and being movable for altering the flow of air through the radial channel.
- 30           2. The system of claim 1, further comprising a sensor for sensing thickness of the blown film after the film solidifies, and a mechanical mover for moving the barriers in response to measurements from the sensor.
- 35           3. The system of claim 2, wherein the barriers are pistons, and the mover includes a servo-controlled motor for moving circumferentially around the blown film, the mover selectively adjusting the pistons.
- 40           4. The system of claim 1, wherein the barriers are movable manually.
- 45           5. The system of claim 4, wherein the each of the barriers is threaded and can be screwed to allow more or less air flow.
- 50           6. The system of claim 5, wherein the radial channels are defined by a top wall, a bottom wall, and side walls, the barrier being mounted in and movable relative to the top wall.
- 55           7. The system of claim 1, wherein the system has one and only one set of lips for providing air to the external surface of the blown film as the film exits the extrusion die.

5        8.     The system of claim 1, wherein the system has two and only two sets of lips for providing air to the external surface of the blown film as the film exits the extrusion die.

10      9.     The system of claim 1, wherein the barrier is located and configured such that a pressure drop within the radial channel across the barrier is at least 50% of the pressure drop across the lips.

15      10.    The system of claim 1, wherein the barrier is located and configured such that a pressure drop within the radial channel across the barrier is at least 100% of the pressure drop across the lips.

20      11.    A thickness control system for controlling the thickness of a blown film by providing air to the blown film when in liquid form and provided from an extrusion die, the system comprising:

25      an inlet for receiving air;

30      lips for providing air to an external surface of the blown film as the blown film exits the die, the lips arranged to be around the blown film as the blown film exits the die;

35      an annular region for providing air inwardly from the inlet to the lips such that all the air provided into the annular region is passed through to the lips; and

40      elongated radially oriented blocks movable for controlling a cross section of air flow through the annular region.

45      12.    The system of claim 11, further comprising a sensor for sensing thickness of the blown film after the film solidifies, and a mechanical mover for moving the barriers in response to measurements from the sensor.

50      13.    The system of claim 11, wherein each of the barriers has a threaded rod that can be turned manually to move the elongated block.

55      14.    The system of claim 13, wherein the radial channels are defined by a top wall, a bottom wall, and side walls, the threaded rod being mounted in and movable relative to the top wall.

5           15. The system of claim 11, wherein the system has one and only one set of lips for providing air to the external surface of the blown film as the film exits the extrusion die.

10           16. The system of claim 11, wherein the system has two and only two sets of lips for providing air to the external surface of the blown film as the film exits the extrusion die.

15           17. The system of claim 1, wherein the barrier is located and configured such that a pressure drop within the radial channel across the barrier is at least 50% of the pressure drop across the lips.

20           18. The system of claim 1, wherein the barrier is located and configured such that a pressure drop within the radial channel across the barrier is at least 100% of the pressure drop across the lips.

25           19. A method for controlling the thickness of blown film from an extrusion die with an external air cooling device around the film as the film exits the die, the external air cooling device having a first set of lips for providing cooling air to an external surface of the film, an input for receiving air, and a plurality of radially oriented channels for directing the received air inwardly to the first set of lips such that all the air provided into the channel is passed through to the lips, the method comprising adjusting a position of at least one barrier in at least some of the radial channels to alter the air flow through the channels.

30           20. The method of claim 19, further comprising sensing thickness of the blown film after the film solidifies, mechanical moving the barriers in response to measurements from the sensor.

35           21. The method of claim 1, wherein the adjusting includes manually moving the barriers.

40           22. The method of claim 21, wherein each of the barriers is threaded and the adjusting includes rotating the threaded barrier to allow more or less air flow.

5           23. A method for controlling the thickness of blown film from an extrusion die with an external air cooling device around the film as the film exits the die, the external air cooling device having a first set of lips for providing cooling air to an external surface of the film, an input for receiving air, an annular region defined by top and bottom walls for directing the received air inwardly to the first set of lips such that all the air provided into the annular region is passed through to the lips, and a series of radially elongated blocks in the annular region and movable relative to the top and bottom walls, the method comprising adjusting a position of at least one barrier in the annular region to alter the air flow through the region.

10          24. The method of claim 23, further comprising sensing thickness of the blown film after the film solidifies, mechanical moving the barriers in response to measurements from the sensor.

15          25. The method of claim 23, wherein the adjusting includes manually moving one or more rods coupled to respective blocks.

20          26. The method of claim 25, wherein the each of the rods is threaded and the adjusting includes rotating the threaded rod to allow more or less air flow.

25          27. The method of claim 23, wherein the movement of a block creates a pressure drop of at least 50% of the pressure drop of the lips.

28. The method of claim 19, wherein the movement of a barrier creates a pressure drop of at least 50% of the pressure drop of the lips.